

FENCE IT!

Suggested Grade/s

9th or 10th Grade Geometry

SD Mathematics Strand & Standard (*Primary for Task*)

Geometry

9-12.G.1.2 Students are able to identify and apply relationships among triangles.

Task Summary

Students calculate the area and perimeter of similar and/or congruent triangles to determine the amount of fencing needed to partition a parcel of land.

Time and Context of Task

1-2 class periods. Groups of 2 or 3 can be used or the task can be done individually.

For use after completing the study of the Pythagorean Theorem, congruence of, similarity of, and area of triangles, and possibly right triangle trigonometry.

Materials Needed

Paper or Graph Paper, Pencil, Protractor, Calculator

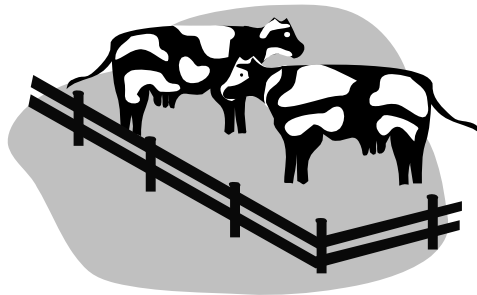
Author and Lead Teacher for This Task

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You have inherited an isosceles triangular shaped piece of land from your grandparents. You would like to fence this property and partition it into four triangular regions with the same area and perimeter for your cattle. From a point one-quarter mile north of your grandparents farm the directions and distances to the other two vertices that form the triangular plot of land (consecutive and in order) are 1.5 miles $N25^\circ W$ and 2 miles $N80^\circ E$ ($N25^\circ W$ is 25 degrees counterclockwise from North and $N80^\circ E$ is 80 degrees clockwise from North). The distance from the last vertex back to the starting point is 2 miles. Draw an accurate sketch of the original triangle, label each vertex (corner post) of the four regions, and name all congruent and similar triangles (if any). Calculate the area and perimeter of each of the four triangular regions. In your calculations, round all final solutions to the nearest thousandth. Prepare a brief presentation for the class which justifies your findings.



CONTENT STANDARDS

Primary Standard

Strand Name: Geometry

SD Goal: Students will use the language of geometry to discover, analyze, and communicate geometric concepts, properties, and relationships.

Indicator 1: Use deductive and inductive reasoning to recognize and apply properties of geometric figures.

Standard: 9-12.G.1.2 Students are able to identify and apply relationships among triangles.

Supplemental Standards

Strand Name: Geometry

SD Goal: Students will use the language of geometry to discover, analyze, and communicate geometric concepts, properties, and relationships.

Indicator 1: Use deductive and inductive reasoning to recognize and apply properties of geometric figures.

Standard: 9-12.G.1.1 Students are able to apply the properties of triangles and quadrilaterals to find unknown parts.

Strand Name: Measurement

SD Goal: Students will apply systems of measurement and use appropriate measurement tools to describe and analyze the world around them.

Indicator 1: Apply measurement concepts in practical applications.

Standard: 9-12.M.1.3 Students are able to use formulas to find perimeter, circumference, and area to solve problems involving common geometric figures.

NCTM Process Standard

Communication: Use the language of mathematics to express mathematical ideas precisely.

Communication: Communicate their mathematical thinking coherently and clearly to peers, teachers, and others.

Reasoning and Proof: Select and use various types of reasoning and methods of proof.

Problem-Solving Strategies

- Estimation and check
- Drawing pictures, graphs, and tables
- Simplifying the problem
- Looking for patterns

ASSESSMENT TOOLS

Task Rubric

	Advanced	Proficient	Basic	Below basic
9-12.G.1.2 Students are able to identify and apply relationships among triangles.	Draws and justifies valid and precise conclusions about relationships within congruent and/or similar triangles to solve the problem.	Student is able to use deductive reasoning and known properties of congruent and/or similar triangles to find other properties or relationships within the triangles.	Student is able to recognize and name congruent and/or similar triangles in the problem.	Draws no conclusion or draws an invalid conclusion.
Graphical Representation	Sketch displays an accurate representation of the problem with strong visual appeal.	Sketch displays an accurate representation of the problem with some attention to detail.	Sketch displays a representation of the problem with some inaccuracies.	Sketch displays an inappropriate representation of the problem or provides no sketch.
Correctness of Areas and Perimeters of Triangular Regions	Student work is accurate, reasonable, complete and properly labeled.	The majority of student work is accurate, reasonable, complete and properly labeled.	Some of the student work is accurate, reasonable, complete and properly labeled.	Student work shows little evidence of an attempt to find solutions.
Communicate Mathematically	Clearly and consistently uses language that is mathematically correct.	Uses clear language that frequently includes appropriate mathematical terminology.	Uses language that sometimes is mathematically correct.	Uses vague language that does not use mathematical terminology.
Convincing Presentation	Presentation shows complete understanding of the mathematical concepts used. It is organized, clear, and convincing.	Presentation shows substantial understanding of the mathematical concepts used. Some organization but not very convincing.	Presentation shows some understanding of the mathematical concepts used. Very little organization. Conclusions are not convincing.	Presentation shows very limited understanding of the underlying concepts needed or no attempt to convince.

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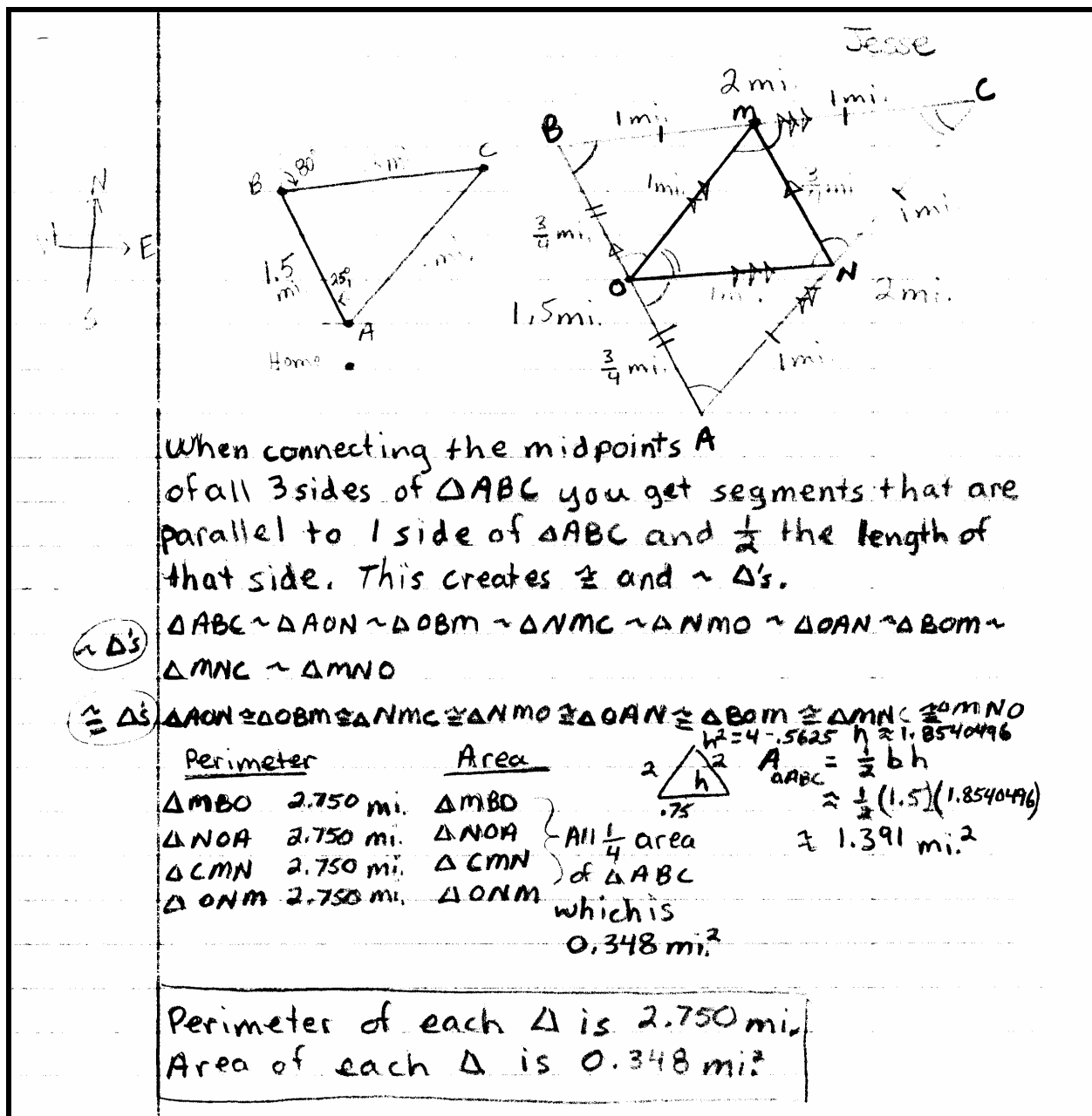
Student Work Samples



As you examine the samples, consider the following questions:

- In light of the standard/s addressed and the assessment tools provided, what evidence does the work provide that students are achieving proficiency in the knowledge and skills addressed by the standard/s for the task?
- Is the task/activity well designed to help students acquire knowledge and demonstrate proficiency? Is the task/activity clearly aligned with the standards? In what ways would you adapt the task/activity to better meet the needs of your students?

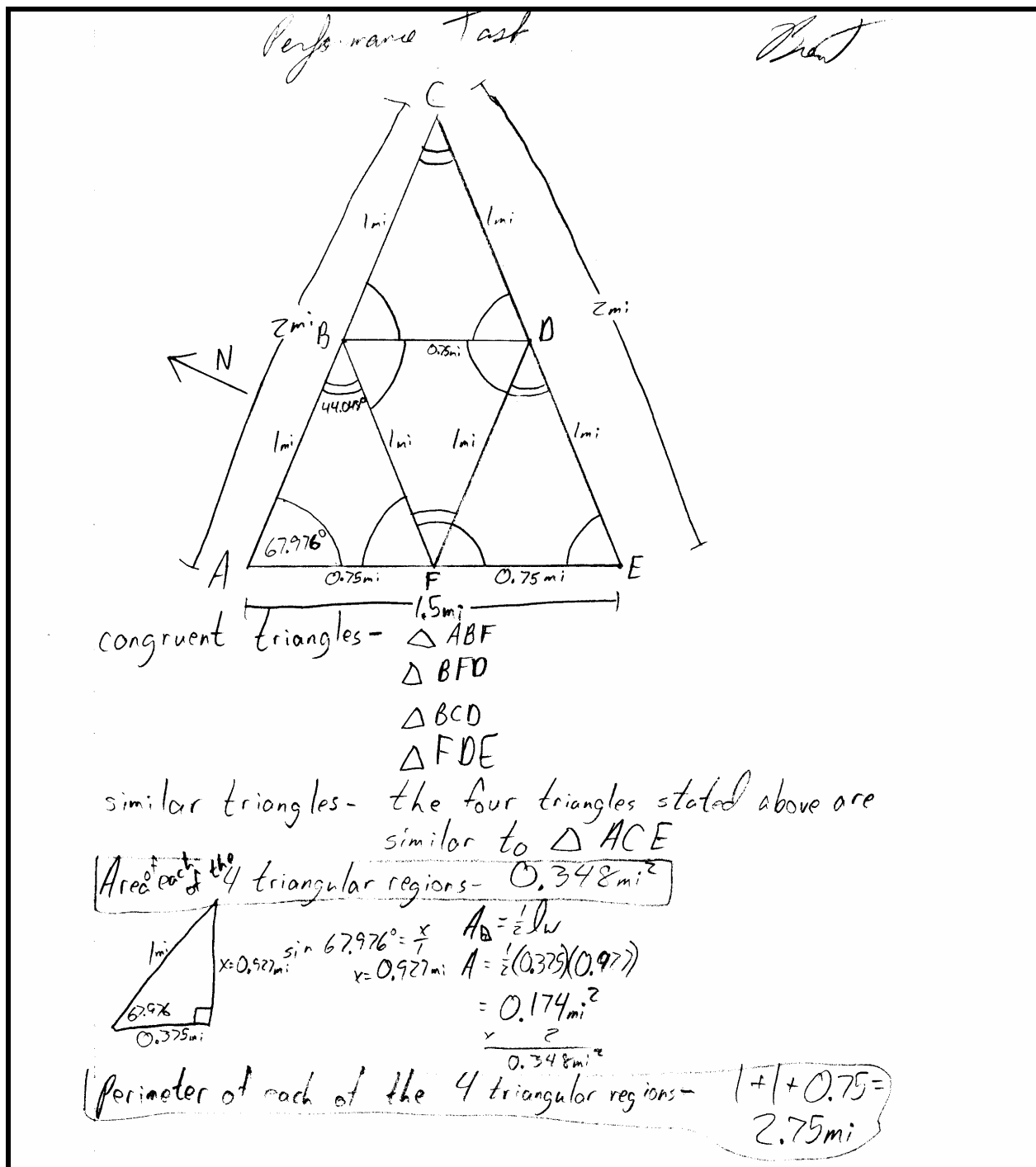
Student #1 Work Sample



Looking at Student Work – Instructor notes and rating for work sample #1:

Based on the assessment rubric this student meets all criteria to be considered advanced.

Student #2 Work Sample

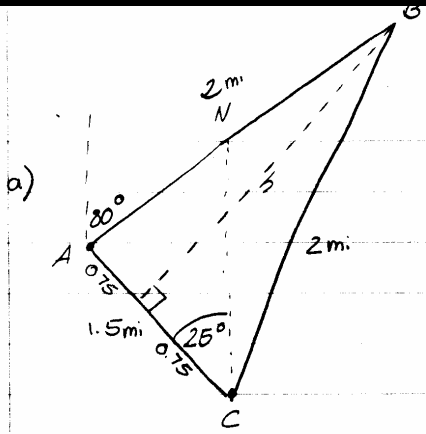


Looking at Student Work – Instructor notes and rating for work sample #2:

Based on the assessment rubric this student meets all criteria to be considered advanced.

Student #3 Work Sample

a)



EC Gomez 10-27-04

$$A = \frac{1}{2}bh$$

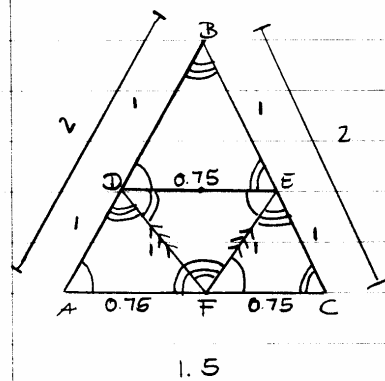
$$h^2 + (0.75)^2 = 2^2$$

$$\sqrt{2^2 - (0.75)^2} = h$$

$$1.854 \text{ mi} = h$$

$$A = \frac{1}{2} \cdot 1.5 \cdot 1.854$$

$$A = \underline{\underline{1.39 \text{ mi}^2}}$$



$\triangle ADF \cong \triangle CEF$

$\cong \triangle EFD$

$\cong \triangle OBE$

$\sim \Delta$'s

1) Corr Δ 's \cong

2) Corrs in proportion

Looking at Student Work – Instructor notes and rating for work sample #3:

Based on the assessment rubric this student meets all criteria to be considered proficient. Area was not specifically found for all four triangles. If more detail were added to this paper, this student could have easily been considered advanced.

INSTRUCTIONAL NOTES

Author Comments

This activity was given in the fall to advanced algebra students who had just completed geometry the year before. If students divide the isosceles triangle into four equal regions without using midpoints of the original sides they will need some right triangle trigonometry skills to complete the task.

Task Extensions

If the teacher provides a sketch of the problem to be solved, students may have a better chance at showing what they know about properties of congruent and similar triangles.

Common Strategies

Students who sketch a large enough diagram seemed to understand and make connections easier.

Common Misunderstandings

Some students had trouble sketching the triangular plot of land due to the bearings given in the problem. If students are unfamiliar with this type of mathematical terminology the teacher may have to provide the diagram for students so that they can visualize the problem. Some students may not divide the triangle using midpoints of its sides.

Appropriate Technology

Graphing or Scientific Calculator

Resources

SD Mathematics Content Standards

<http://www.doe.sd.gov/contentstandards/math/index.asp>

SD Assessment and Testing

<http://www.doe.sd.gov/octa/assessment/index.asp>

The National Assessment of Educational Progress (NAEP)

<http://www.doe.sd.gov/octa/assessment/naep/index.asp>

National Council of Teachers of Mathematics

<http://nctm.org/>

Looking at Student Work

<http://www.lasw.org/index.html>